

“SPICE”ing up Optics

E.J. Mannel

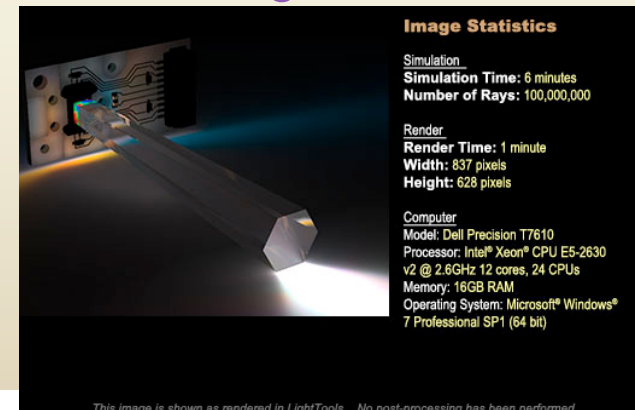
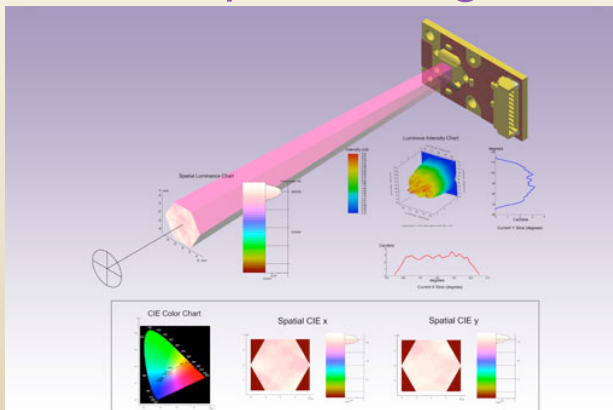
EMCal Weekly Meeting

4-Oct-2016



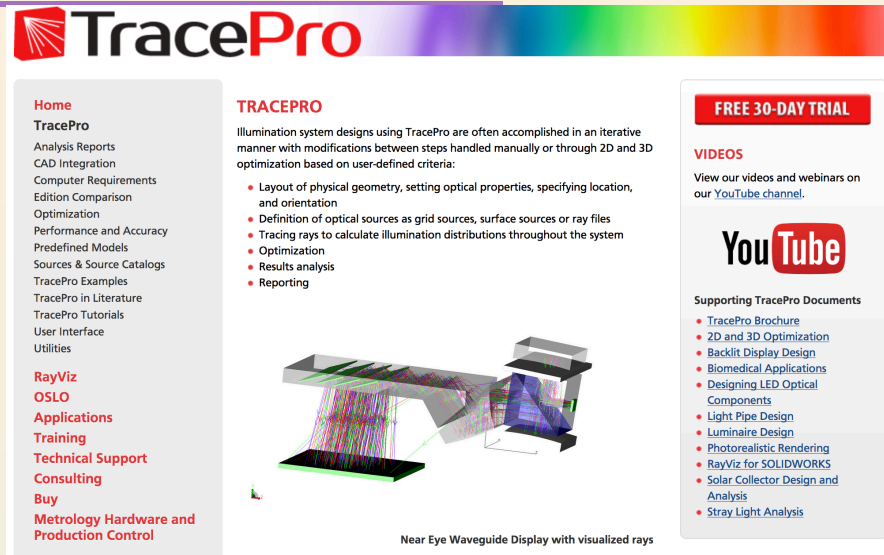
Optical Design Software Packages

- Lambda Research:
 - <http://lambdares.com/>
- ZEMAX: 
 - <http://zemax.com/>
- Synopsys:
 - <https://optics.synopsys.com/>
- Lighttools:
 - <http://www.lighttec.fr/optical-design-software/lighttools/>



TracePro

- John pointed me to Lambda Research-
<http://www.lambdaresearch.com/>



Light Pipe Design using TracePro

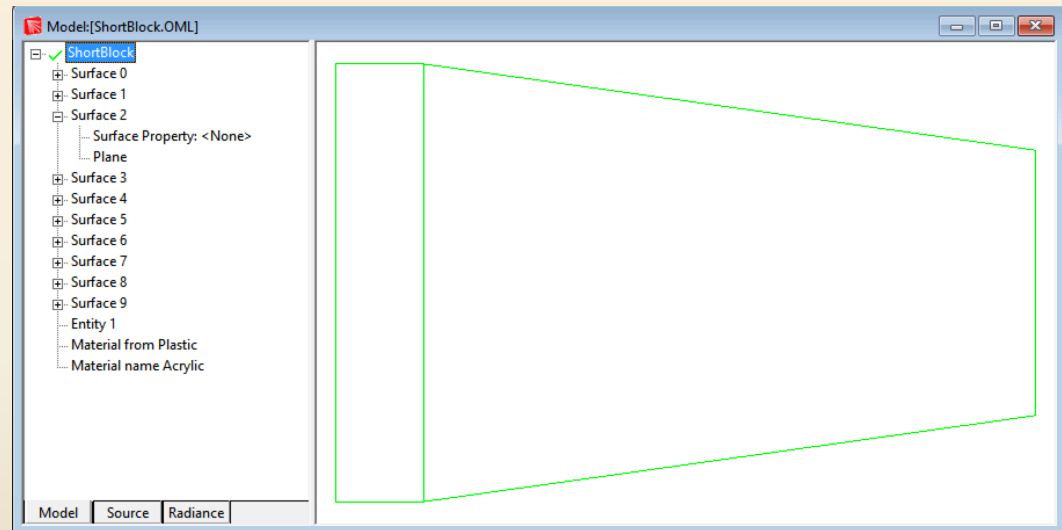
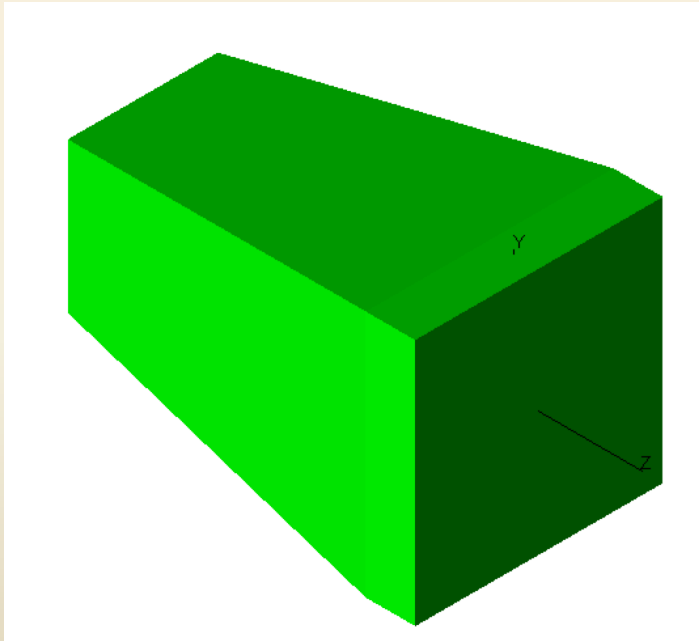
Design Intricate Light Pipes Optimized
for Utility, Efficiency, Color, and Uniformity

Disclaimers

- I have not:
 - Come up with the final answer.
 - Optimized anything.
 - Explored the full phase space of the program.
- I have:
 - Played around with it somewhat.
 - Tried some different designs.
 - Learned a lot more about optics than I use to know.
 - Had Fun!
- The balance of the presentation is to demonstrate what is possible with one package, TracePro

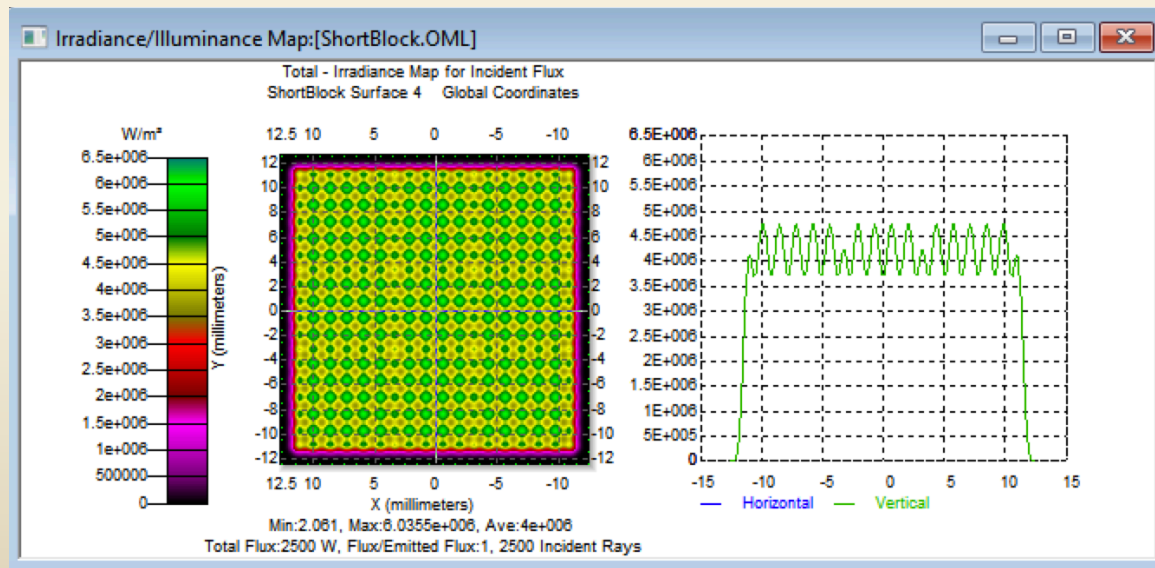
Square light guide

- Simple square light guide **similar** to prototype guide
 - 25 x 25 mm² at base, 15 x 15 mm² at other end, 40 mm long
 - Acrylic material, with default surfaces

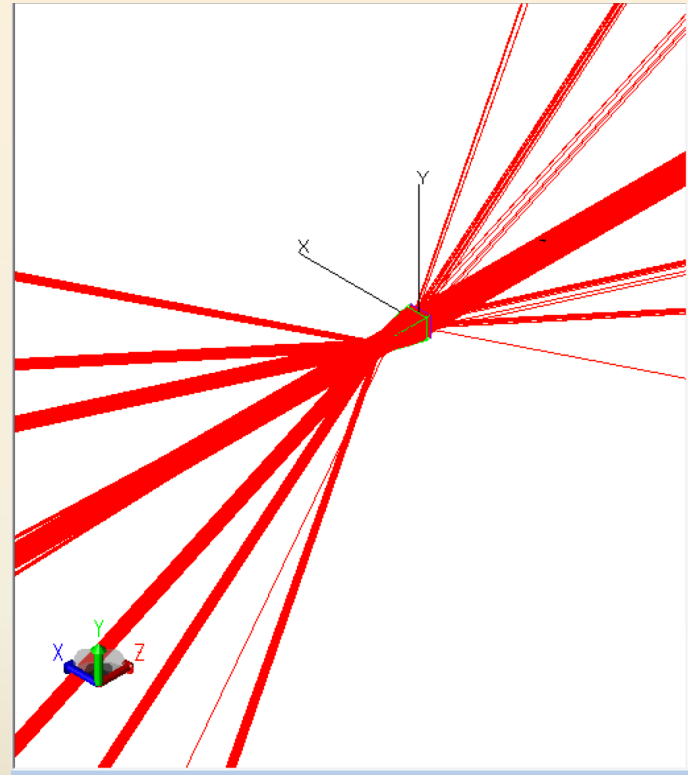
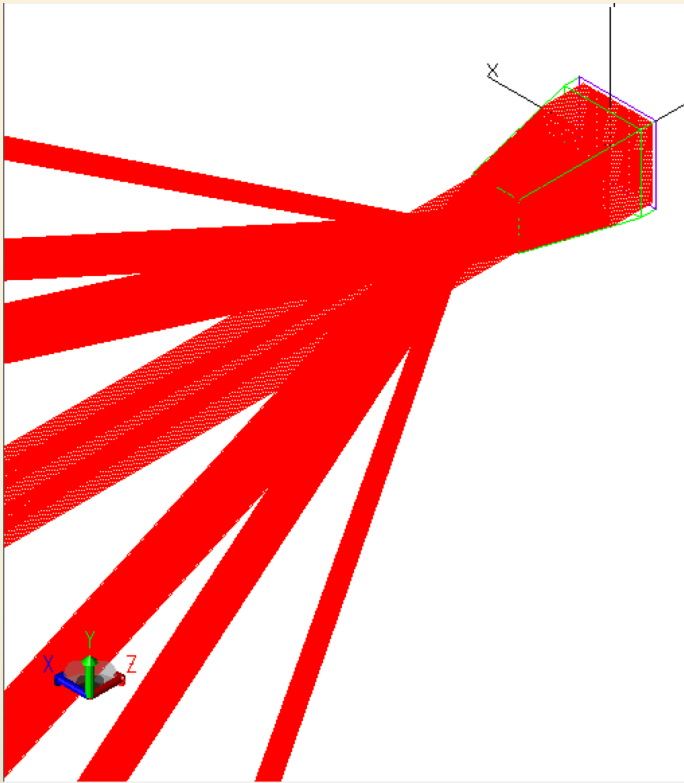


Light Grid

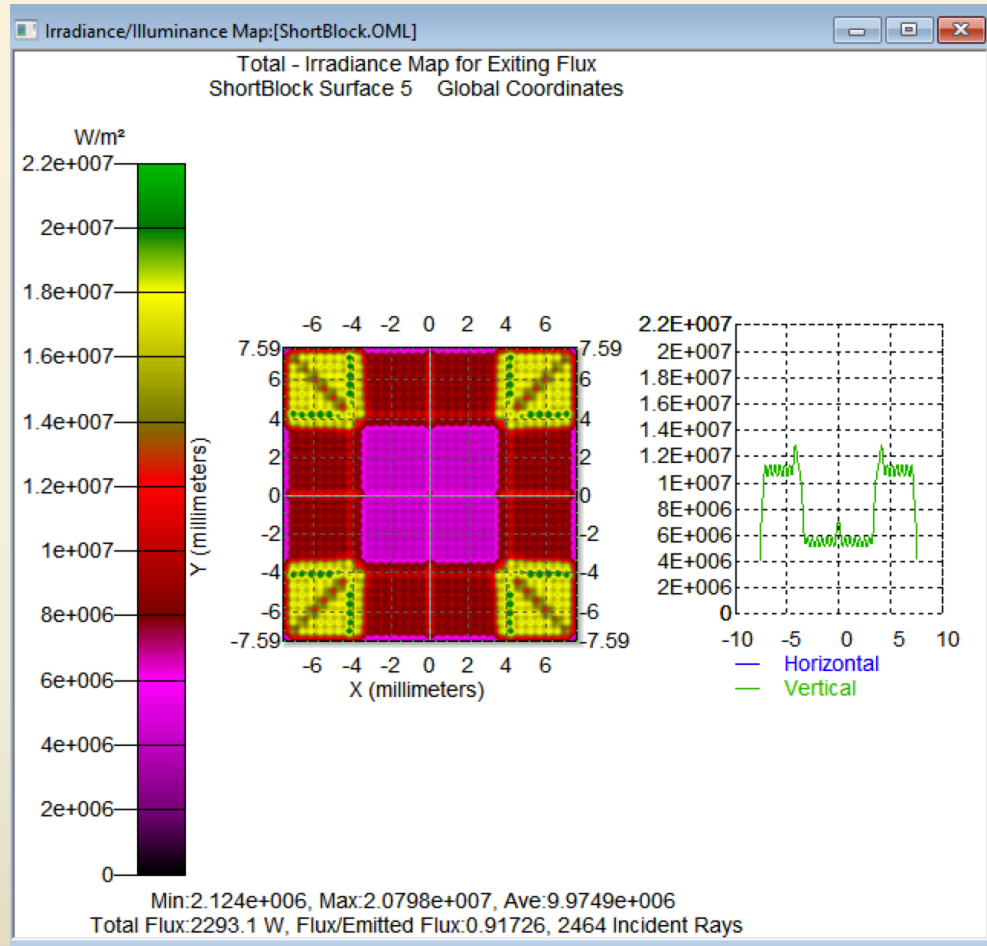
- Define a light grid to illuminate the “large” end.
 - 23 x 23 mm²
 - 25 x 25 points in a grid
 - Uniform beam, half angle of 1 degree
 - 460nm wavelength
- Incident flux on front surface:



Transmission Through Light Guide

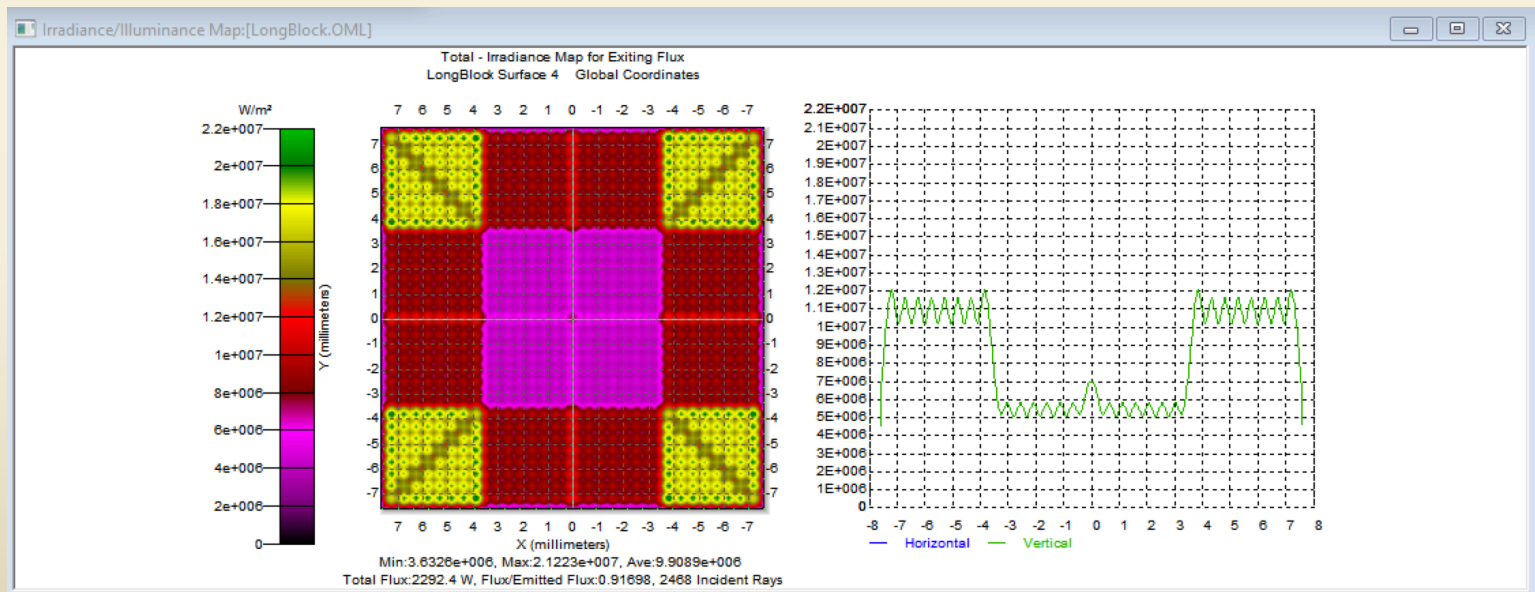
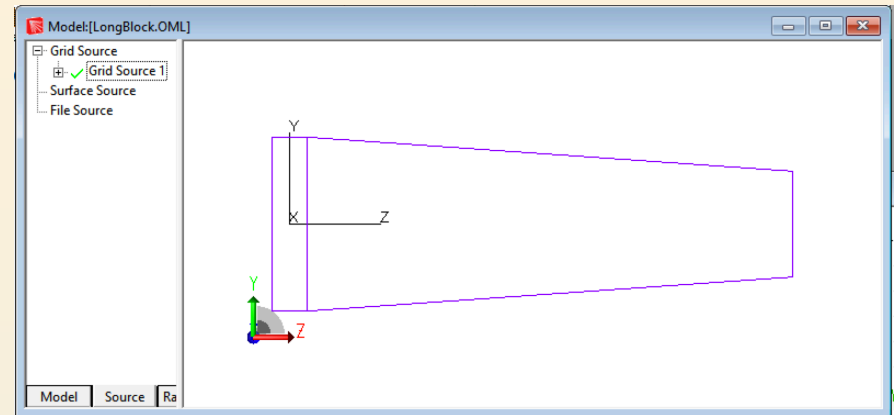


Exiting Irradiance Plot at Back Side



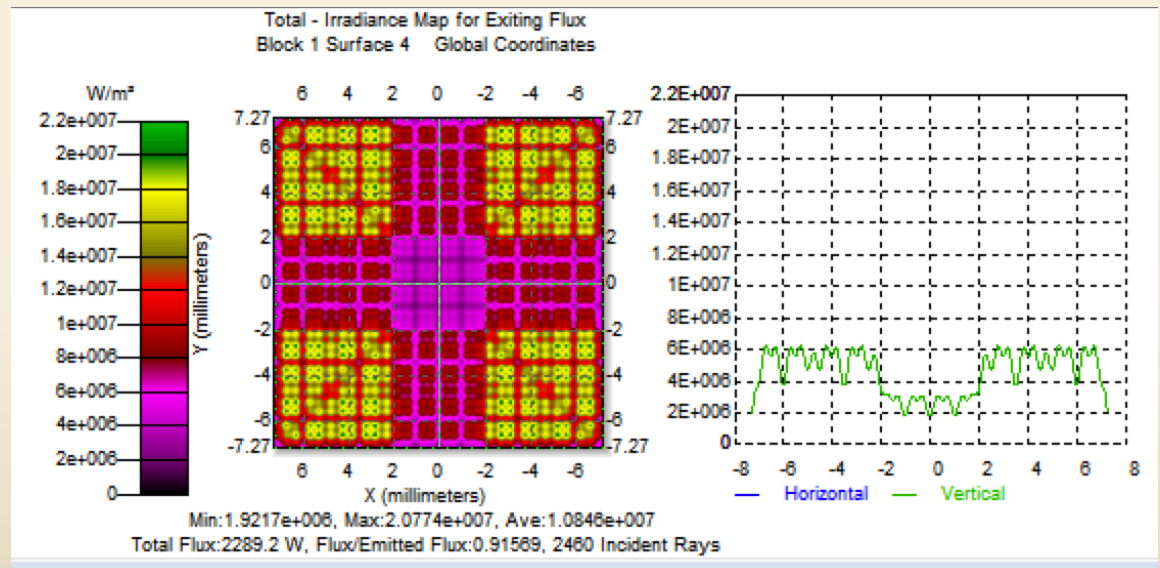
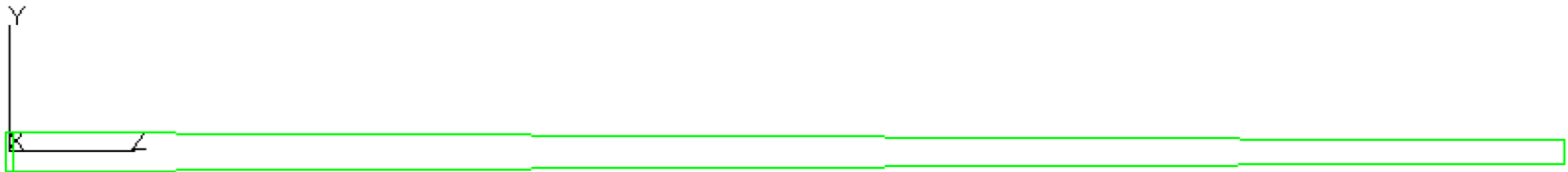
Longer Light Guide

- Increase length to 70mm
- 25 x 25 mm² at front
- 15 x 15 mm² at back



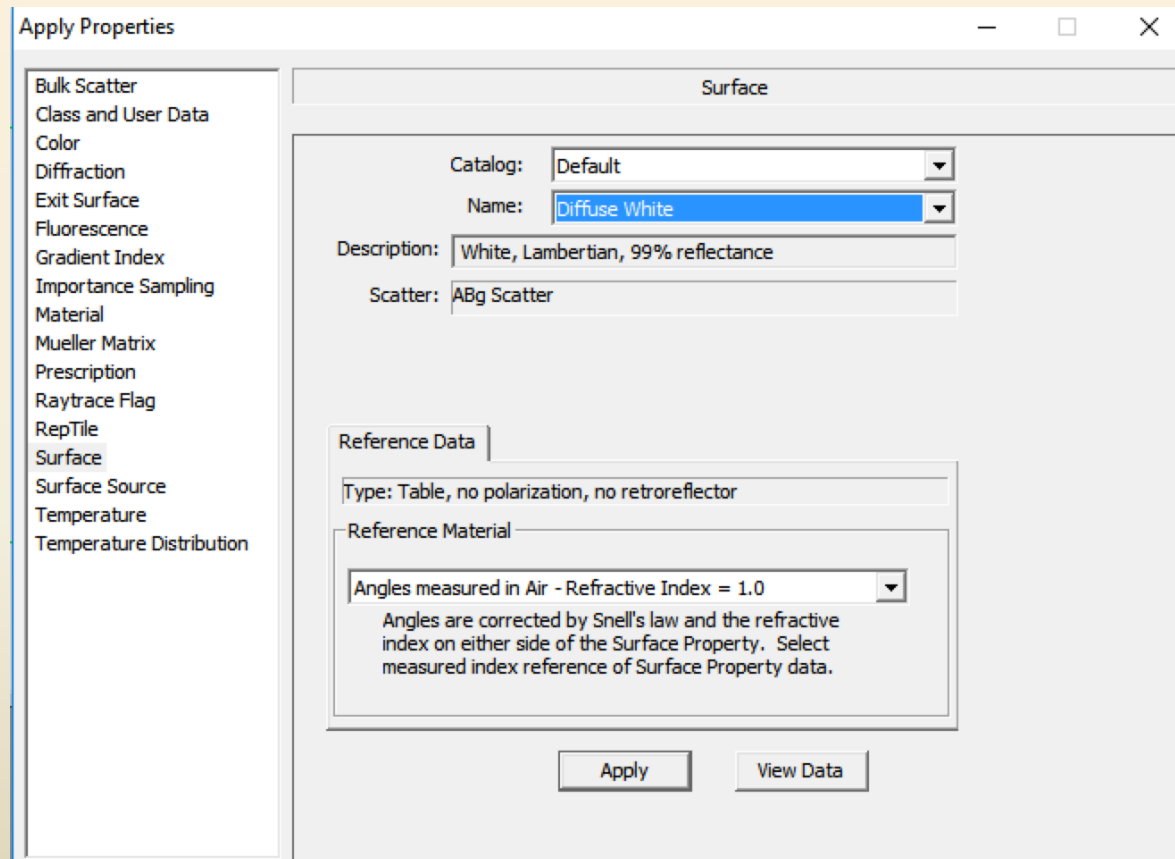
Even Longer?

- 1m long:

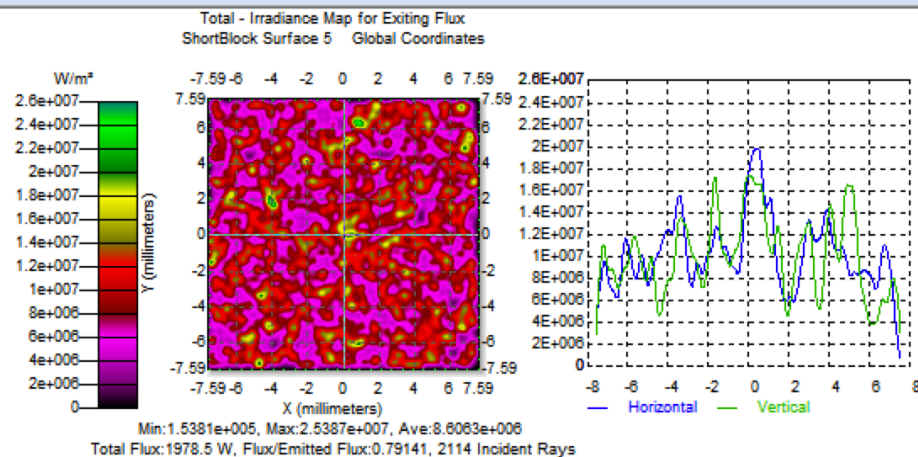
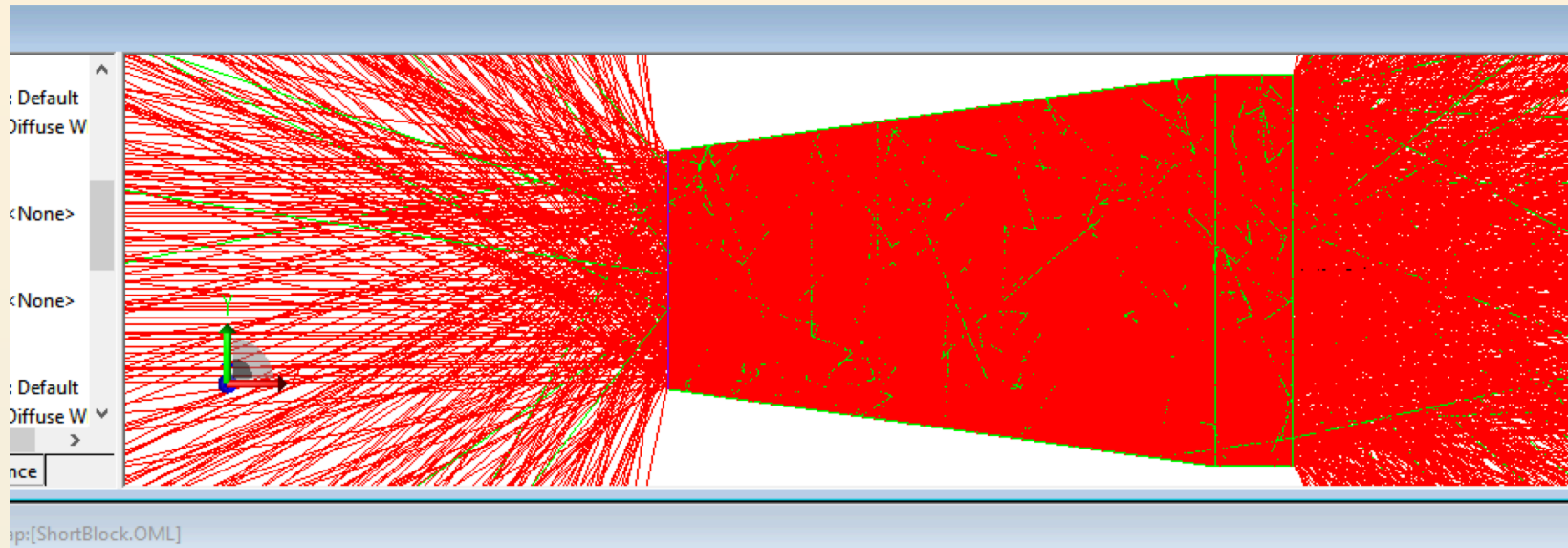


What about coating the side

- Back to original “short” block
- Make the side surfaces “Diffuse White”

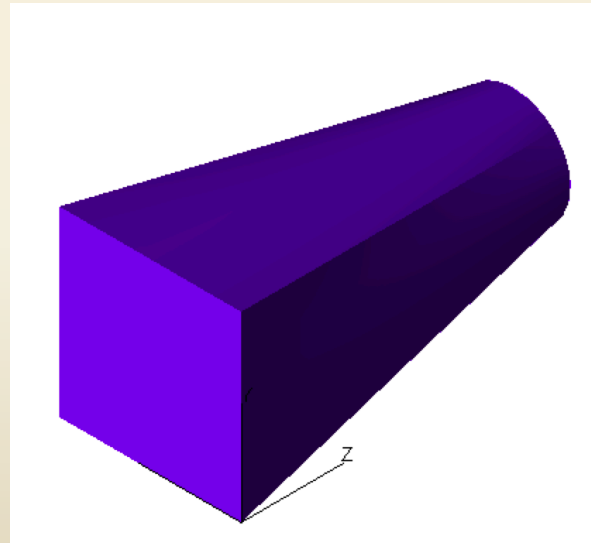
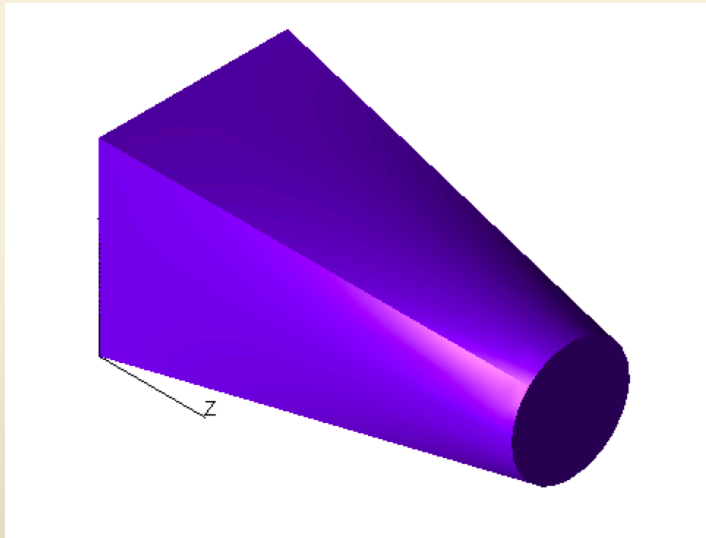


Look at the Radiance Plots for the Back Side

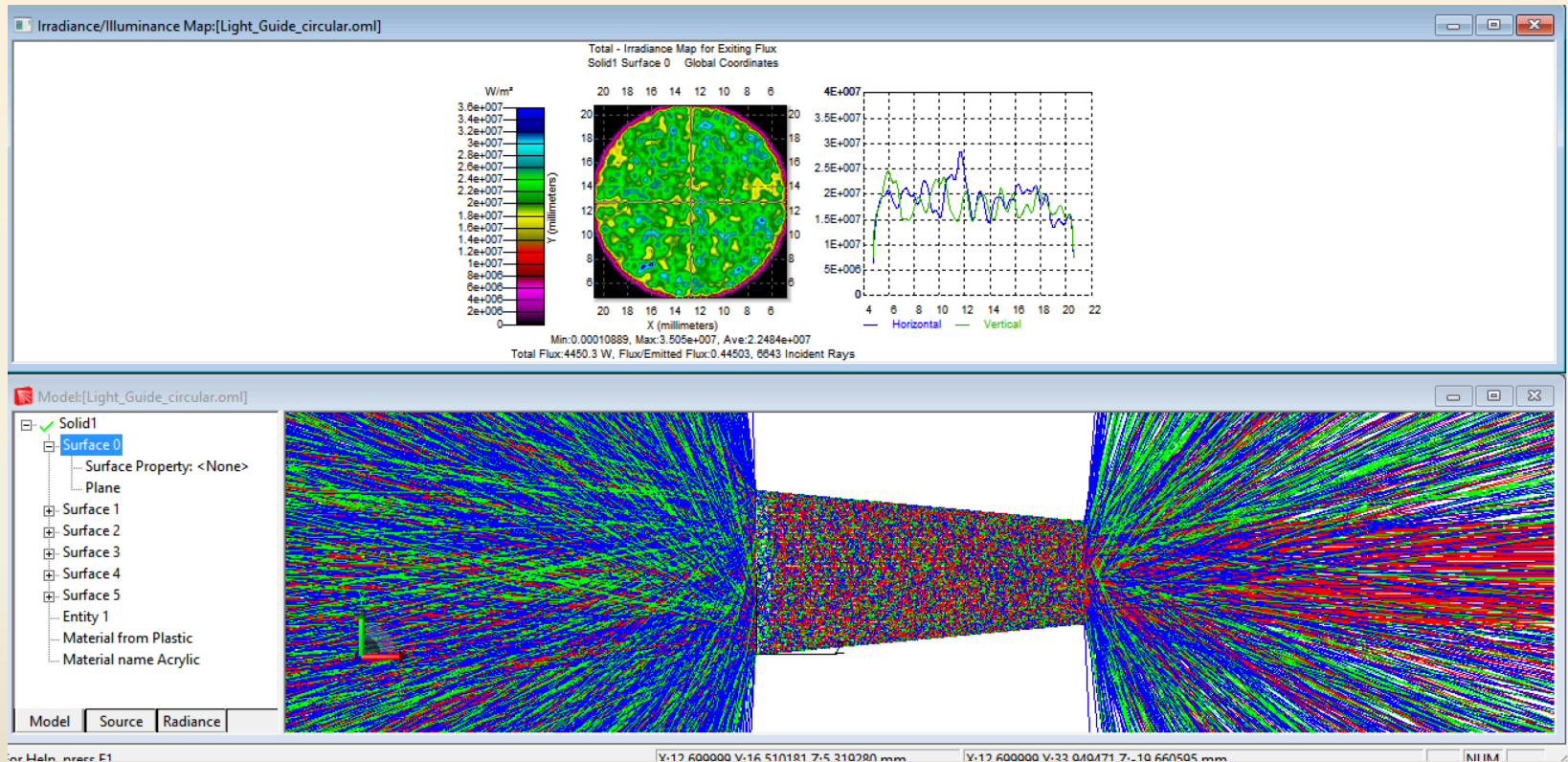


A Different Shape?

- Asked Ritchie to generate a step file that went from a square to a circle
- Dimensions are not the same as other light guides
- Same material, default surface
- Same source grid and wave length

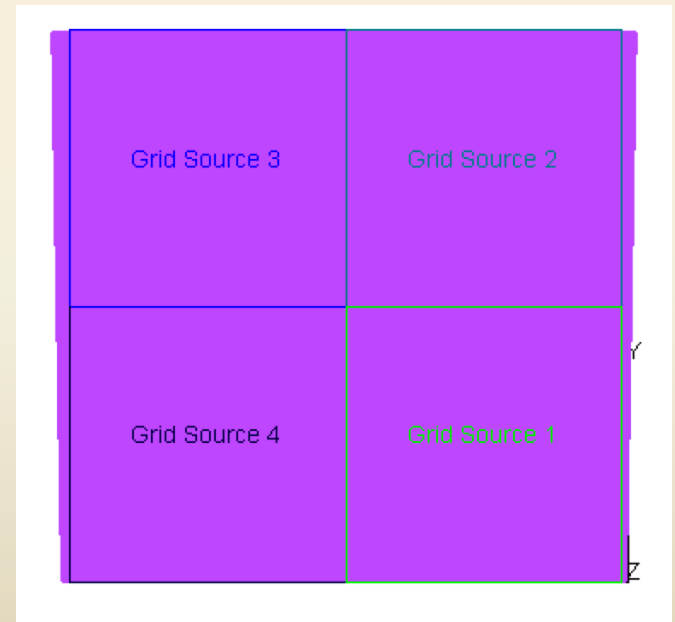
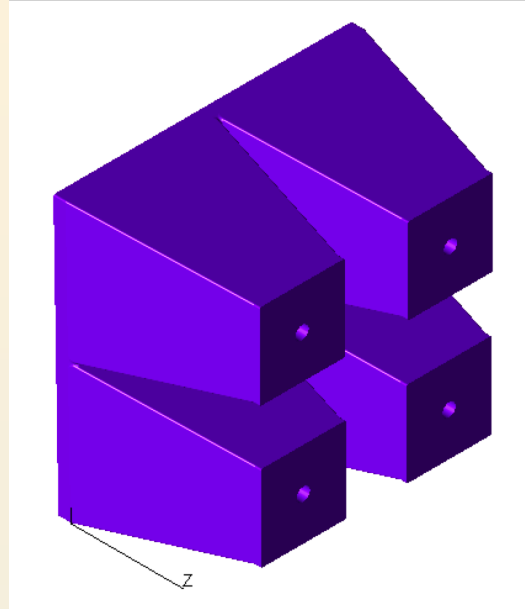


Irradiance Map for the Back Surface



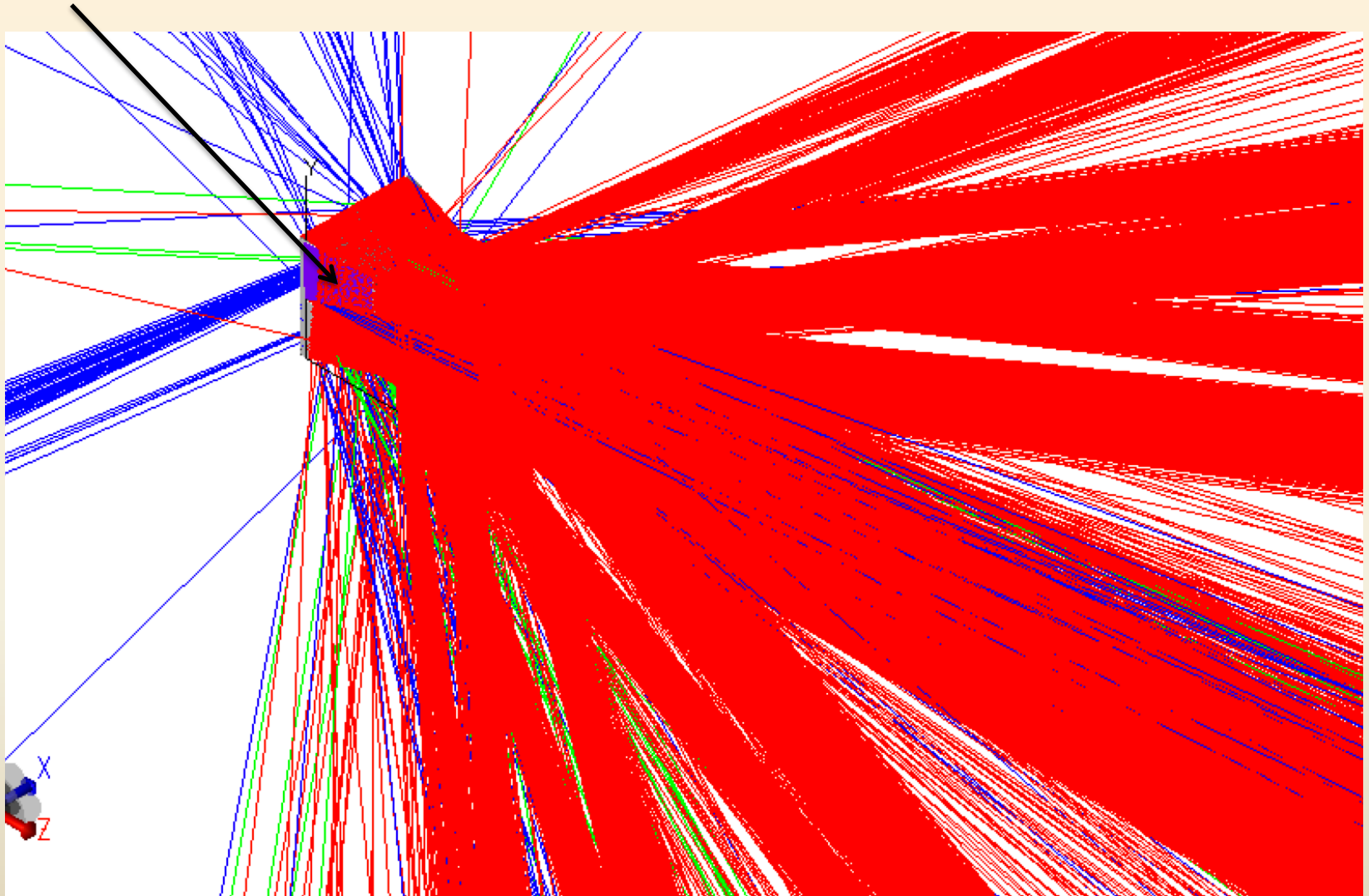
Import the 2x2 Light Guide

- Use step file from Ritchie/Spencer/Dan
- Define 4 light grids on front surface
- One cone has diffuse white surface



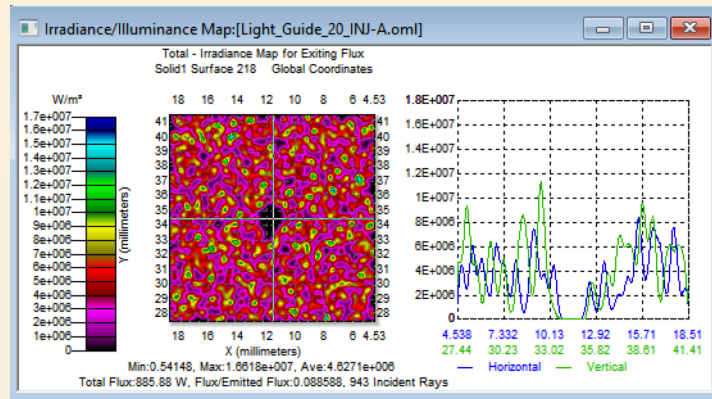
Light it Up

Diffuse White Surface

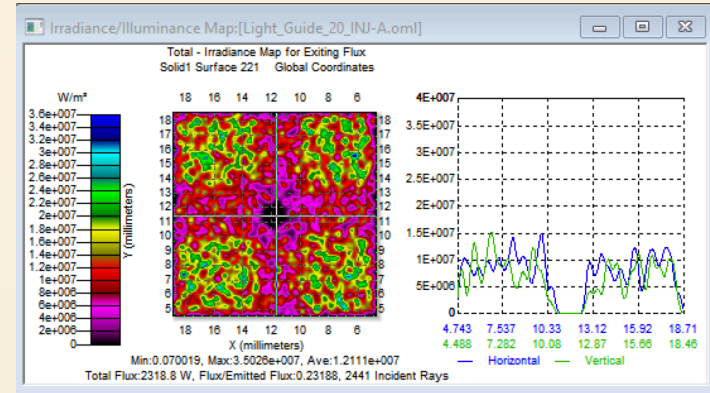


Irradiance Plots

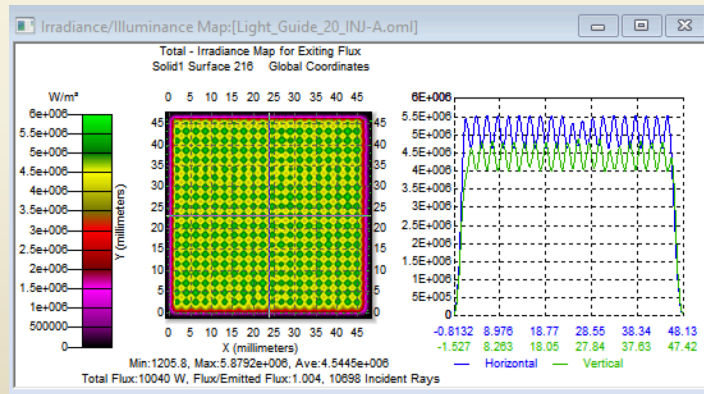
With Diffuse White Surface



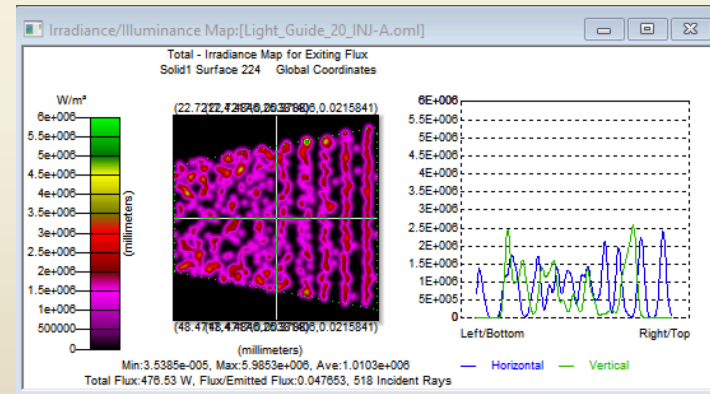
Without Diffuse White Surface



Front Surface



Side Surface



Final Comments

- Number of commercial products available for designing optical wave guides
- Companies also provide design consulting
- Good project for student wanting to learn optical engineering

